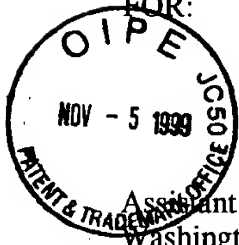


## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Alan, John Brasier : Art Unit: 1771  
Serial No.: 09/397,618 : Examiner:  
Filed: September 16, 1999 :  
FOR: NON-WOVEN FABRIC :

CLAIM TO RIGHT OF PRIORITY

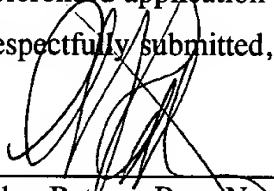
Assistant Commissioner for Patents  
Washington, D.C. 20231

S I R :

Pursuant to 35 U.S.C. 119, Applicant's claim to the benefit of filing of prior Great Britain Patent Application No. 9820165.0, filed 17 September 1998, as stated in the inventor's Declaration, is hereby confirmed.

A certified copy of the above-referenced application is enclosed.

Respectfully submitted,

  
Allan Rather, Reg. No. 19,717  
Attorney for Applicant

AR/lk

Enc - Certified Copy of Great Britain Application

Dated: November 1, 1999

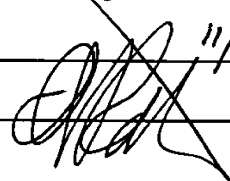
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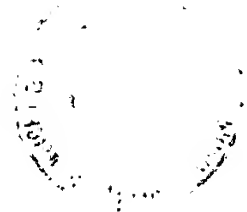
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#3  
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The Patent Office  
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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

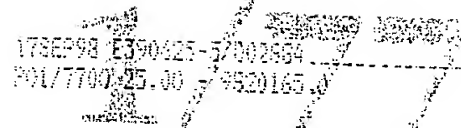
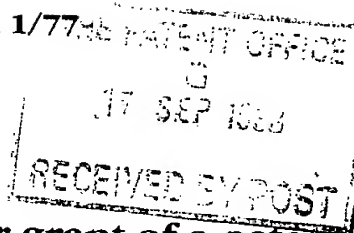
Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.



Signed *Andrew Gersey*  
Dated 21 September 1999

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Date: 1st 1977  
(Rule 10)



# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
Gwent NP9 1RH

1. Your reference

P22155/LXM/SCR/BOU

2. Patent application number

9820165.0

(The Patent Office will fill in this number)

17 SEP 1998

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Milliken Industrials Limited  
Wellington Mill Street  
BURY  
B08 8LD  
UK

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

605618003

RECEIVED  
17 SEP 1998  
TECHNICAL ROOM

4. Title of the invention

"Non-Woven Fabric"

5. Name of your agent (if you have one)

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

373 Scotland Street  
GLASGOW  
G5 8QA

Patents ADP number (if you know it)

1198013

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

See note (d))

## Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

7 ✓

Claim(s)

-

Abstract

-

Drawing(s)

1 + 1 - 100

10. If you are also filing any of the following, state how many against each item.

Priority documents

-

Translations of priority documents

-

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

-

Request for preliminary examination and search (*Patents Form 9/77*)

-

Request for substantive examination (*Patents Form 10/77*)

-

Any other documents  
(please specify)

-

11. I/We request the grant of a patent on the basis of this application.

Signature

*Murgitroyd & Co*

Date

MURGITROYD & COMPANY

16/09/98

12. Name and daytime telephone number of person to contact in the United Kingdom

Beverley Ouzman

0141 307 8400

### Warning

*After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.*

### Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*
- Write your answers in capital letters using black ink or you may type them.*
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.*
- Once you have filled in the form you must remember to sign and date it.*
- For details of the fee and ways to pay please contact the Patent Office.*

1       NON-WOVEN FABRIC

2  
3       The invention relates to a non-woven fabric, the use of  
4       this non-woven fabric in the manufacture of tennis  
5       balls and the tennis balls thus produced.

6  
7       For many years tennis balls have been covered with a  
8       woven textile material having a surface predominantly  
9       composed of wool fibres. The scale structure of the  
10      wool fibre is utilised to produce the characteristic  
11      felted surface appearance of the ball. Nowadays a  
12      mixture of polyamide and wool felt is commonly used for  
13      covering tennis balls. Such felt is usually made of a  
14      mixture of wool and nylon fibres at a ratio of about  
15      60% wool and 40% nylon and preferably 50% each, and it  
16      is desirable that the back side of the felt (which is  
17      the side which will be stuck to the ball) be made of a  
18      material which provides a good adhesion when it is  
19      glued on the internal rubber sphere of the ball.  
20      Usually such backing is made of cotton.

21  
22      Needlefelting techniques produce a non-woven fabric  
23      according to the following method : An appropriate  
24      blend of fibres, either dyed or undyed, is carded and  
25      cross lapped to form a substantially horizontal fibre

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1 web. The fibres of the web are provided in a generally  
2 planar configuration and are superimposed according to  
3 successive horizontal patterns. This fibre web is then  
4 passed through the needlefelting machine. Such machine  
5 has at least one panel of barbed needles (or  
6 needleboard). Advantageously the machine has  
7 needleboards arranged on opposite sides of the fabric  
8 which may be arranged successively. As the fibre web is  
9 horizontally passed through the machine, barbed needles  
10 of each needleboard are punched vertically through the  
11 fabric web and then removed. The vertical passage of  
12 the barbed needles through the fibre web provokes a  
13 vertical entanglement of the fibres as the barbs of the  
14 needles carry some portion of the fibres along their  
15 pathway.

16  
17 It is difficult using this technique to produce high  
18 quality tennis ball coverings due to limitations in the  
19 wear and covering capabilities of the fabric thus  
20 obtained. More particularly the felt so produced  
21 either wears too quickly or is consolidated to such an  
22 extent that the ball covering capability is impaired.

23  
24 It has now been discovered that a felt produced with a  
25 needlefelting machine having a curved needleboard  
26 and/or which ensures fibre entanglement at variable  
27 angles exhibits good characteristics of both wear and  
28 covering capabilities and is particularly suitable for  
29 tennis ball coverings.

30  
31 Such machines are available from the Austrian Company  
32 Textilmaschinenfabrik Dr Ernst Ferher AG and are known  
33 in the Trade as machines incorporating "Ferhrer H1  
34 Technology". However this technique has never been  
35 used in order to produce a non-woven fabric having  
36 characteristics suitable to be use as a tennis ball

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1 covering.

2

3 **STATEMENT OF THE INVENTION**

4

5 One object of the invention is the use of a non-woven  
6 fabric for a tennis ball covering, said fabric having  
7 an entanglement of fibres and made from the passage of  
8 an horizontal fibre web through a needlefelting machine  
9 having curved needleboard panels which provide barbed  
10 needles to penetrate said fabric at angles which are  
11 non-perpendicular with respect to the plane of the  
12 fabric.

13

14 Preferably the angles range from about  $-16^{\circ}$  to  $+35^{\circ}$   
15 from the vertical of the plane of the material.

16

17 Preferably the curved needleboard panels provide barbed  
18 needles to penetrate said fabric also at a  
19 perpendicular angle with respect to the plane of the  
20 fabric.

21

22 Preferably the curved needleboard panels provide barbed  
23 needles to penetrate said fabric at a number of  
24 different angles with respect to the plane of the  
25 fabric.

26

27 Preferably the arc of the needleboard and fabric  
28 passage is constant.

29

30 A further object of the invention is the use of a non-  
31 woven fabric for a tennis ball covering, said fabric  
32 having an entanglement of fibres and made by the  
33 passage of a planar fibre web through a needlefelting  
34 machine having at least one needleboard panel which  
35 provides barbed needles to penetrate said web at non-  
36 perpendicular angles with respect to the plane of the

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1 fabric.

2

3

4

5 Preferably the angles range from about  $-16^{\circ}$  to  $+35^{\circ}$   
6 from the vertical of the plane of the material.

7

8 Preferably the curved needleboard panels provide barbed  
9 needles to penetrate said fabric also at a  
10 perpendicular angle with respect to the plane of the  
11 fabric.

12

13 Preferably the curved needleboard panels provide barbed  
14 needles to penetrate said fabric at a number of  
15 different angles with respect to the plane of the  
16 fabric.

17

18 Preferably the arc of the needle board and fabric  
19 passage is constant.

20

21 A further object of the invention is the use of a non-  
22 woven fabric for a tennis ball covering having an  
23 entanglement of fibres, said fibres being entangled in  
24 a horizontal direction, a vertical direction and at a  
25 wide range of angles from the vertical direction.

26

27 A further object of the invention is a non-woven fabric  
28 having an entanglement of fibres, said fibres being  
29 entangled in a horizontal direction, a vertical  
30 direction and at a wide range of angles from the  
31 vertical direction.

32

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1  
2 A further object of the invention is a tennis ball made  
3 with a fabric according to the invention.

4 A particular embodiment of the invention will now be  
5 described with reference to the attached drawing.  
6

7 DESCRIPTION OF THE DRAWING

8 Fig. 1 is a schematic representation of the process to  
9 make a tennis ball covering to be used according to the  
10 invention.  
11

12 An appropriate blend of fibres, either dyed or undyed,  
13 is carded and cross-lapped to form a fibre web 10.

14 Preferably this web would weigh between 350 grams per  
15 square metre and 850 grams per square metre depending  
16 on the weight required for the finished product and  
17 would be composed of a mixture of wool and polyamide  
18 fibres although other fibres could be incorporated or  
19 may be substituted if appropriate.  
20

21 This fibre web 10 is then passed through a pre-needling  
22 needlefelting machine 11. Such pre-needling machine is  
23 advantageously of the type as sold under the Trade Name  
24 Fehrer H1 Technology by the Austrian Company  
25 Textilmaschinenfabrik Dr Ernst Ferher AG.  
26

27 Preferably the pre-needling machine 11 has a curved  
28 needleboard 12 containing about 5000 needles and be of  
29 down punch configuration.  
30

31 The needles selected for pre-needling would depend on  
32 the results required. Preferably these needles would  
33 be 3 inch 40 gauge needles with regular barbs. Draft,  
34 needle penetration depth and penetration density would  
35 vary according to product requirements. For a tennis  
36 ball covering of good quality it is preferred to use

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1 a draft of about 15% and to provide a penetration depth  
2 of about 10 millimetres at about 80 penetrations per  
3 square centimetre.

4  
5 The pre-needled batt of fibres 13, together with an  
6 appropriate scrim material 14, preferably a polyester  
7 or polyamide warp knit of around 75 grams per square  
8 metre weight, would then be passed through a finish  
9 needling machine 15 or series of finish needling  
10 machines.

11  
12 Preferably the finish needling operation would be  
13 carried out through a single finish needling machine  
14 set with two needle boards 16 & 17, each board  
15 containing approximately 5000 needles, the first board  
16 being of up punch configuration and the second board of  
17 down punch configuration. Each of these boards 16 & 17  
18 are curved.

19  
20 Preferably, in this configuration, the scrim material  
21 14 would be fed into the finish needling machine 15  
22 from above the fibre batt 13. Thus the first (up  
23 punch) needle board 16 of the finish needling machine  
24 15 would needle fibres from the fibre batt 13 through  
25 the scrim material and the second (down punch) needle  
26 board 17 would needle fibres back through the scrim  
27 material 14 into the fibre batt 13.

28  
29 Advantageously the finish needling machine 16 would be  
30 a machine sold as Fehrer H1 Technology by  
31 Textilmaschinenfabrik Dr Ernst Ferher AG.

32  
33 The needles selected for finish needling would depend  
34 on the results required. Preferably these needles  
35 would be 3 inch 40 gauge needles with regular barbs.  
36 Draft, needle penetration depth and penetration density

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would vary according to product requirements and, by varying these parameters it is possible to alter the flexing characteristics, surface appearance and wear characteristics of the product. For tennis ball coverings of a good quality it has been found that a penetration of 14 millimetres downpunch and a penetration of 10 millimetres up-punch with a punch density of 80 penetrations per square centimetre without drafting can produce good results

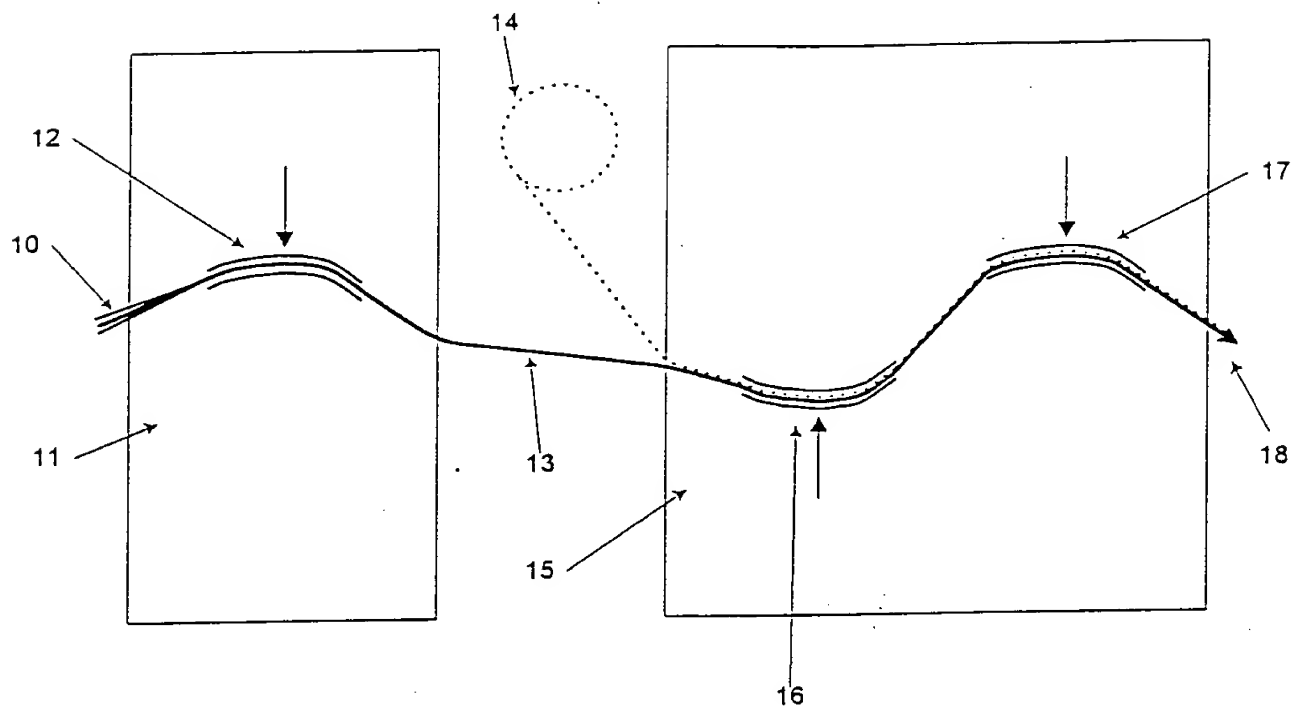
The needlefelt tennis ball covering material so produced may or may not be subjected to further processing. For example, a woollen milling process can, if required, be used to enhance the felt characteristics, particularly appearance and some aspects of wear. Additionally the product may be dyed at this stage and dried. Also a shearing or cropping process may be appropriate.

The new needling process generates fibre entanglement by moving fibres through the thickness of the felt at angles other than the conventional 90 degrees to the felt surface thus giving increased fibre to fibre contact at lower punching densities. This allows the generation of a felt with high levels of fibre entanglement without increased consolidation. By using such technology and controlling the depth of needle penetration it is possible to vary and control the density of the felt through its thickness.

To make the tennis ball, the felted fabric thus obtained is glued on an internal rubber sphere. The scrim material provides a smooth backing surface enabling good adhesion between the felted fabric and the internal rubber sphere of the ball.

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# Schematic to Show H1 Machine Configuration for Tennis Ball Felt



## KEY

- 10 Cross Lapped Web of Fibre
- 11 Pre-Needling Machine
- 12 Down Punch Pre-Needling Head
- 13 Pre-Needled Batt
- 14 Scrim Material
- 15 Finish Needling Machine
- 16 Up Punch Needling Head
- 17 Down Punch Needling Head
- 18 Needed Product

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